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The Lateral-line Sensory System in the Caecilian Family, Ichthyophiidae (Amphibia: Gymnophiona.)

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The sense organs commonly known to anatomists as the lateral-line or neuromast system developed in early aquatic Chordata (Ostracoderms) and continued to appear in subsequently developed aquatic groups. It was a sensory system believed to serve the organism in adjusting to an aquatic environment. When an aquatic animal having such a system changes to a terrestrial environment, the system seemingly no longer functions and tends to disappear. This is true of certain species of fish that assume a semiterrestrial habitat (Symbranchidae). It is also true of many Amphibia that have a free-swimming larval period after hatching and which, at transformation from larval to adult form, usually assume a terrestrial habitat. The system is present in numerous Caudata during the larval period. One species of the genus *Taricha* is said to lose the system on transformation to a land habitat. Later in life when it again resumes the aquatic habitat the system reappears and presumably again functions! Most Salientia that have a free-swimming larval period seek a terrestrial habitat on transformation and the system is lost. However, in certain species that are, as adults, semiaquatic, the system may be partially retained (*Rana hexadactyla* and *R. cyanophlyctis*). Others may remain permanently aquatic and retain more of the system (*Xenopus*).

The neuromast organs of the lateral-line system are usually described as groups of sensory cells, each having a hairlike process at its free end and surrounded by supporting cells. These organs are arranged in series that follow the nerves. They are in pits or depressions in the skin which are usually connected by canals filled with a mucous secretion. The series are symmetrically arranged on the two sides of head and body. In most fishes there is a series crossing the head that connects the two sides. If this is present in the caecilians, it is not obvious externally.

The purpose of this paper is to inquire into the character of this sense system in the third order of the Amphibia, the Gymnophiona, especially in

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the family Ichthyophiidae, and to demonstrate that the general pattern occurring in the Asiatic genera is duplicated in a South American genus of the family.

In the order Gymnophiona, Taylor (1968, 1969) recognized four families: the Ichthyophiidae, Scolecomorphidae, Typhlonectidae and Caeciliidae. The fourth family was divided into two subfamilies, the Caeciliinae and the Dermophiinae.

This sense organ was first reported in Gymnophiona by the Sarasins, who found it in *Ichthyophis glutinosus* (1887a,b). They discuss the system (Seitenorgane) and present figures representing the general distribution of the organs (1887a, pl. 5, figs. 42, 51-54); their structural details are discussed and figures are given (1887b, pl. 6, figs. 11-18). Taylor (1960, 1968) has given figures illustrating the general pattern of the cranial part of the system in *Ichthyophis mindanaoensis*, *I. youngorum* and *I. supachaii*. The first two species have a larval life lasting one or two years, during much of which time the lateral-line system is retained. The third species has a larval life of only a few weeks. At the end of this time the animal transforms and the system is lost as it becomes terrestrial in habitat.

Four genera are recognized. Besides the Asiatic *Ichthyophis*, there is another Asiatic genus, *Caudacaecilia*, and two South American genera, *Epicrionops* and *Rhinatrema*. Larvae of *Caudacaecilia weberi*, *C. larutensis* and *C. asplenia* have been examined, all showing traces or parts of the system but none showing it satisfactorily, probably because none was of proper age. It is most probable that the details when found will differ but little from those of *Ichthyophis*.

The characteristics of the system in *Ichthyophis* both in the diagram (Fig. 1) and in the retouched photograph (Fig. 2) may be described as follows: On the dorsal surface of the head two lines of neuromasts, seemingly a continuation of the premaxillary series, pass up over the tip of the snout and form two short groups that terminate back of the level of the nostrils. These are designated *internasals*. Just back of the nostrils the *canthals* begin, curve outward and turn backward. They may be somewhat continuous with the *supraorbitals* that curve above the eyes and terminate slightly above and behind the eyes. Below the nostrils, beginning on the upper lip, is the *infraorbital* series that passes up toward the eye, then curves under it and terminates behind the eye but at a higher level. Beginning somewhat back of the eye and running diagonally to near the level of the line of the mouth is the *genal* series. Farther back and about on a level with the mouth are the *supraspiraculars* terminating above the anterior edge of the open gill slits. Beginning on the lower lip are the *mentals* that curve back on the chin to near the level of the corners of the mouth, their terminal points near to each other.

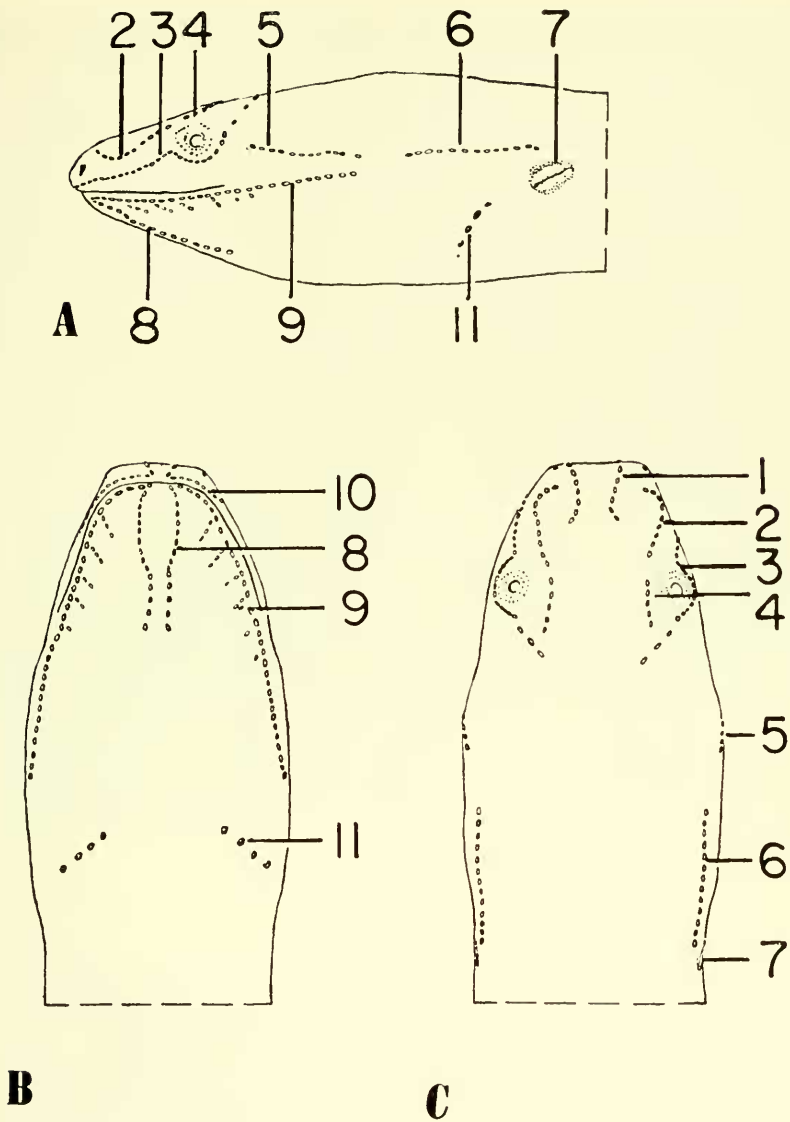


FIG. 1. Neuromast series based on the larval head of *Ichthyophis*. Lateral (A), ventral (B) and dorsal (C) views: 1. internasal series; 2. canthal; 3. infraorbital; 4. supraorbital; 5. genal; 6. supraspiracular; 7. gill slits; 8. mental; 9. infralabial; 10. premaxillary; 11. gular. The three body series are not indicated in the diagrams.

Bordering the lower lip the *infralabials* extend directly backward to near the posterior terminus of the *genal* group. From this series short branches extend backward and inward for a short distance, there being one to three neuromasts visible on each branch. On the beginning of the neck short

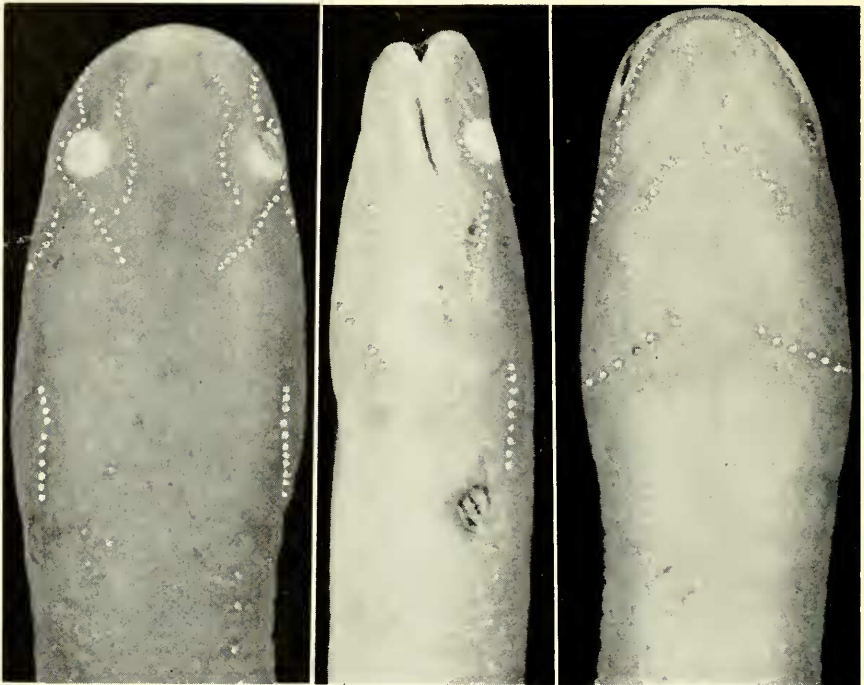


FIG. 2. Head of *Ichthyophis peninsularis* Taylor. Larva. E.H.T.-H.M.S. No. 1836, Bangalore, India. Head width, 5.1 mm; total body length, 140 mm. Retouched. Usually the neuromasts appear whitish. This color may disappear before the neuromast is lost.

groups of neuromasts extend back to near the front level of the gill slits. These are designated the *gulars*.

While not shown in the cranial diagram, there are three lines of neuromasts on each side of the body that reach from the gill region to, or near to, the end of the body. They are designated the *upper*, *middle* and *lower lateral* series. Only rarely are all three visible at the same time on a specimen. It is quite possible that there are other parts of this system which are not obvious to the eye and which might be discovered by histological methods.

The characteristics of the lateral-line system, as seen from the lateral and ventral aspects of *Epicrionops p. petersi*, is best shown in Figure 3. The infraorbital series is nearly complete, as is the genal. The mentals, beginning near the middle of the lower lip, extend back behind the angle of the mouth, more or less contacting the genals posteriorly. Ventrally the infralabials show the numerous short branches to a greater or lesser degree, behind which the mentals may be distinguished. In this species the neuromasts appear distinctly larger and perhaps fewer than in *Ichthyophis* (Fig. 2) and differ somewhat in their general arrangement from that in the diagrammatic Figure 1. The neuromasts on the dorsal surface of the head (Fig. 3) are relatively indistinct,

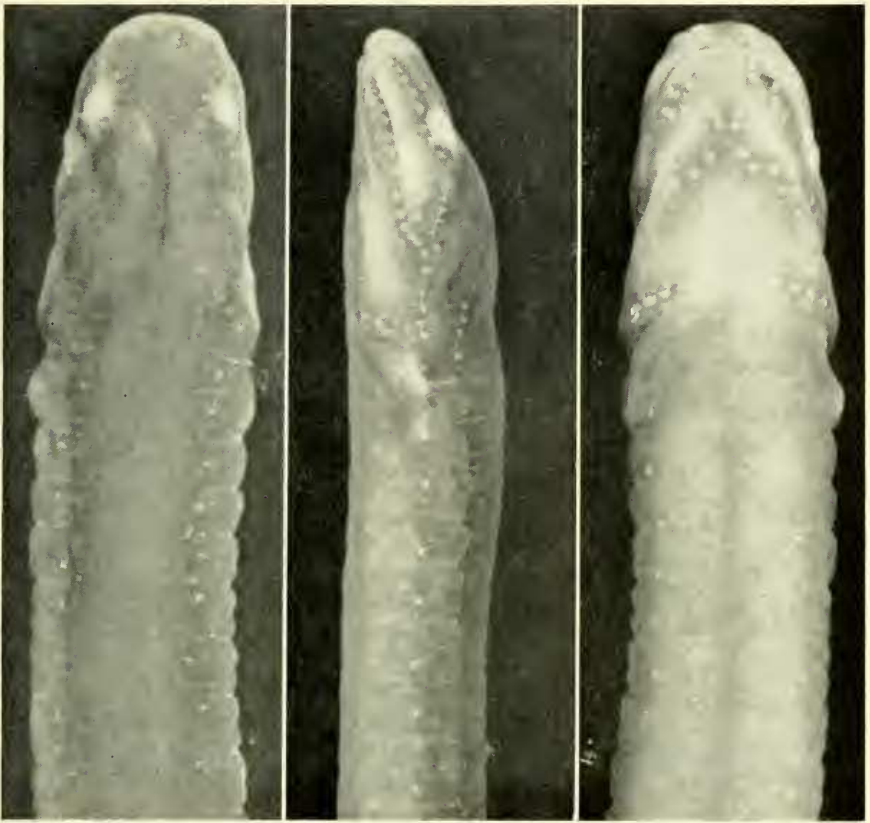


FIG. 3. *Epicrionops petersi petersi* Taylor. Larva. KUMNH No. 119402 (three views of head). Head width, 4.6 mm; total length of specimen, 117 mm. Cordillera del Dué, above Río Coco, 1150 m elev., Napo, Ecuador.

which suggests that they are already tending to disappear. The three linear lateral series are more or less evident, continuing most of the length of the body. Four other specimens of *Epicrionops* (Figs. 4, 5) are shown. What might be regarded a variation is, most probably, only the degree of loss of the neuromasts in older specimens that are preparing to assume the adult characteristics. Measurements recorded suggest that the specimens differ in age and in the degree of development.

In conclusion, insofar as the genera *Ichthyophis* and *Epicrionops* are concerned, one may state that the lateral-line sense organs follow the same general design and the function may be presumed to be the same. Such slender evidence as is available shows that the system in *Caudacaecilia* follows the characteristics of those of *Ichthyophis*. *Rhinatrema*, the most aberrant genus of this family, may or may not be similar. Only two specimens of that genus are known, both adults.

TABLE I. Data on *Epicrionops p. petersi* Taylor.

Number	119399	199397	119400	119398	119401	119402
Total length	150	135	135	125	125	117
Head width	7	6.1	6	5.1	6	4.6
Tail length	8.1	8.2	9	8	5.2	7.5
Body folds	Total circa 234	Primary circa 64	Total circa 231	Primary circa 66	Primary circa 65	Primary circa 66
Tail folds	13	11	11	11	?	?
Premax-max teeth	12-1-13	12-1-12	11-1-11	10-1-11	10-1-9	11-1-11
Prevom-palatine	17-1-12+	18-1-18	17-1-18	16-1-17	17-1-17	15-1-15
Dentary	13-13	13-14	13-14	12-12	15-1-15	14-1-15
Splénial	5-5	6-7	5-5	5-5	6-6	6-5
Gill-slit	1	1	1	1	1	1
Neuromasts						
Internasal series	..	5-4	5-5	4-5
Premaxillary	0	0	0	0	0	0
Supraorbital	4-4	5-5	5-5	4-4	5-5	5-4
Infraorbital	12-12	13-14	13-13	14-14	13-13	13-13
Infralabial	18-18	16-18	17-18	16-16	20-19	18-17
Supraspiracular	4-3	6-4	6-6	3-3	4-6	3-3
Genal	2-3	3-4	3-3	3-3	3-3	3-3
Mental	4-4	4-4	4-4	3-3	3-3	3-3
Lateral (middle)	22	21-20	25	20	20-25	18-?

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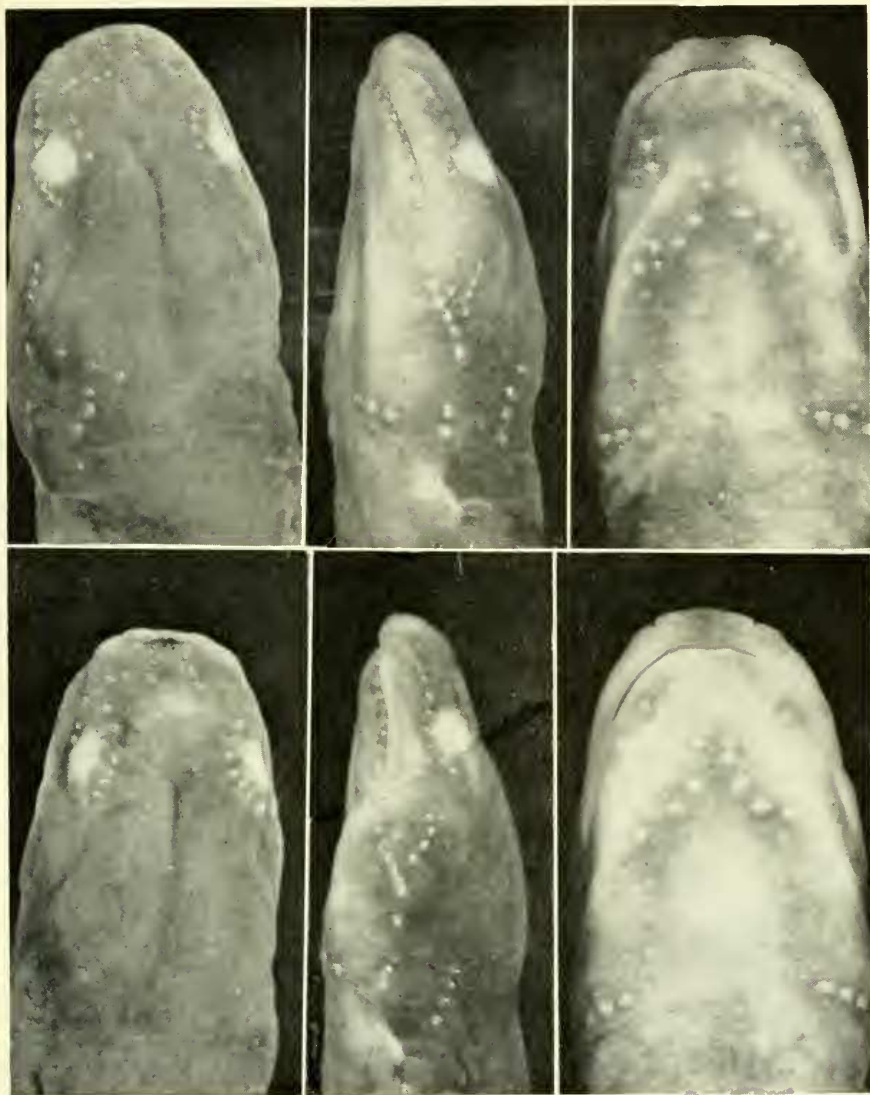


FIG. 4. *Epicrionops petersi petersi* Taylor. Larvae. Upper figures (three views of head), KUMNH No. 119398. Head width, 5.1 mm; total length of specimen, 125 mm. Lower figures (three views of head), KUMNH No. 119401. Head width, 6 mm; total length of specimen, 125 mm. Both specimens from Cordillera del Dué, above Río Coco, 1150 m elev., Napo, Ecuador.

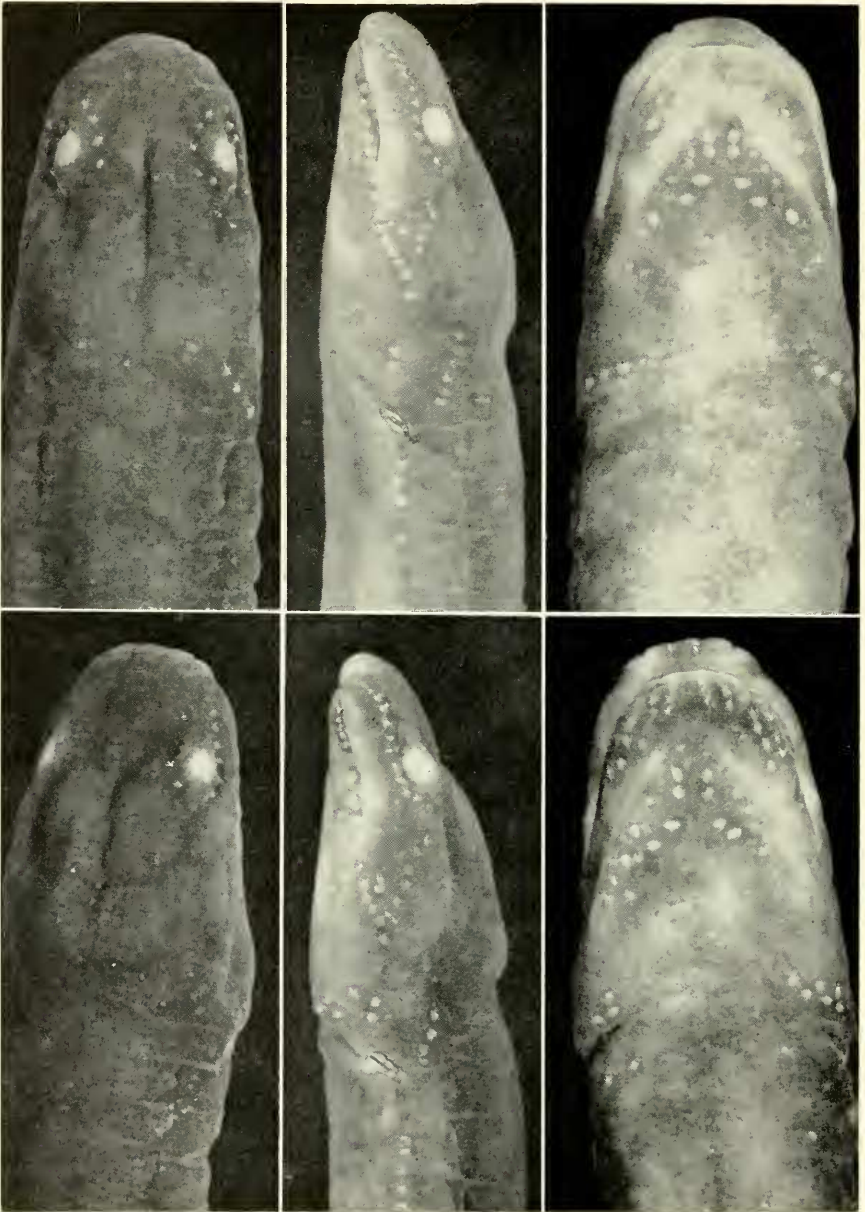


FIG. 5. *Epicrionops petersi petersi* Taylor. Larvae. Upper figures (three views of head), KUMNH No. 119400. Head width, 6 mm; total length of specimen, 135 mm. Lower figures (three views of head), KUMNH No. 119397. Head width, 6.1 mm; total length of specimen, 134 mm. Both specimens from Cordillera del Dué, above Río Coco, 1150 m elev., Napo, Ecuador.